DOCUMENT RESUME

ED 239 076 CE 037 927

TITLE	Electrical Occupations Cluster Guide. Develop and Implement Model Electrical Cluster Program.
INSTITUTION	Portland Public Schools, Oreg.
SPONS AGENCY	Oregon State Dept. of Education, Salem. Career and Vocational Education Section.
PUB DATE	Oct 83
GRANT	26-001-995
NOTE	120p.; Revised edition of "Curriculum Guide for Electrical Occupations," ED 150 401. For related documents, see CE 037 928-931.
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01/PC05 Plus Postage.
DESCRIPTORS	Behavioral Objectives; Career Education; *Career Exploration; Cluster Grouping; Competency Based Education; Curriculum Development; Definitions; Educational Objectives; Educational Planning; *Electrical Occupations; *Employment Opportunities; *Employment Qualifications; Evaluation Criteria; Guidelines; Individualized Instruction; Job Skills; Labor Market; Learning Activities; *Occupational Clusters; Program Development; Program Implementation; Secondary Education; State Curriculum Guides; Student Evaluation; Testing; *Trade and Industrial Education
IDENTIFIERS	Oregon

ABSTRACT

This curriculum guide deals with electrical occupations clusters. The first section of the guide introduces vocational and career education in general, and electrical occupational education in particular; provides definitions of commonly used terms; and lists guidelines for establishing acceptable secondary vocational programs in Oregon. In the next section, a small but representative sample of electrical occupations is analyzed in terms of the labor market trends and common skill requirements, from the student's point of view as well as from the teacher's. Also addressed are goal-based planning and the objectives of occupational clusters, the need for individualized instruction, suggestions for an electrical occupations cluster curriculum, guidelines for establishing a high school cluster program, and ideas for core and elective courses. The fourth section offers program goals, course goals, and learning activities for nine phases of the career education process: safety; technical communications; mathematical calculations; tools and equipment; tests and measurements; assembly, maintenance, and repair; electrical and electronic theory; human relations; and careers. Concluding the guide are a discussion of the need for assessment and suggestions for a number of assessment activities. Appendixes to the guide include a certificate of competency, a job descriptions form, and a brief list of resources. (MN)

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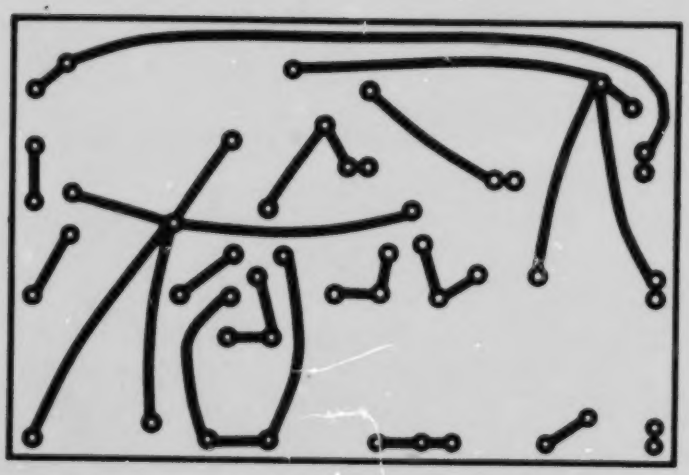

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PORTLAND PUBLIC SCHOOLS

ELECTRICAL OCCUPATIONS CLUSTER GUIDE

DEVELOP AND IMPLEMENT MODEL
ELECTRICAL CLUSTER PROGRAM

GRANT NO. 26-001-995
VEC. NO. 20-462

PROJECT DIRECTOR: CAROL MATARAZZO

PORTLAND SCHOOL DISTRICT 1J
PORTLAND, OREGON

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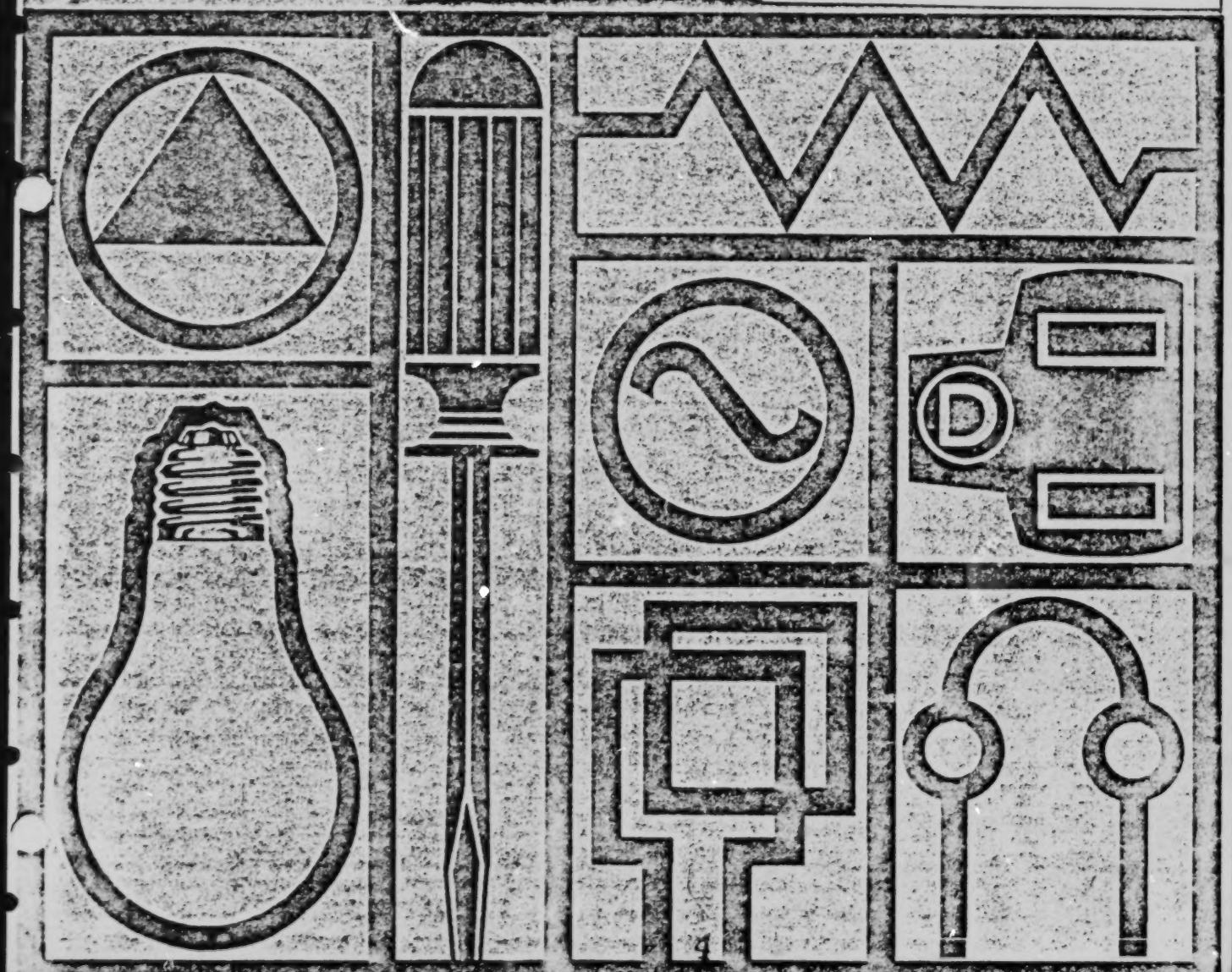
OCTOBER, 1983

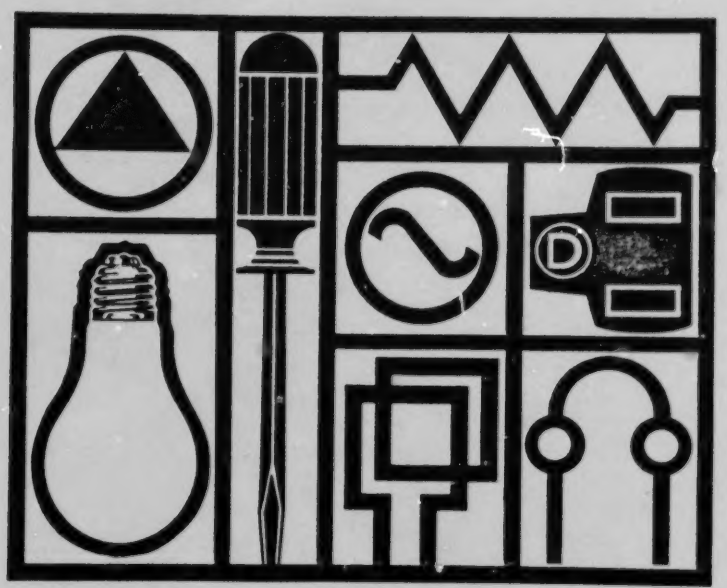
OREGON DEPARTMENT OF EDUCATION
CAREER AND VOCATIONAL EDUCATION DIVISION

OCCUPATIONAL CLUSTER GUIDE

ELECTRICAL OCCUPATIONS

INSIDE ELECTRICIAN
MAINTENANCE ELECTRICIAN
ELECTRONICS ASSEMBLER
ELECTRICAL APPLIANCE REPAIR
ELECTRONIC SERVICE TECHNICIAN
ELECTRONIC TECHNICIAN





CURRICULUM GUIDE FOR ELECTRICAL OCCUPATIONS

Published by:
THE OREGON DEPARTMENT OF EDUCATION

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of Public Instruction

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Revised Edition
1983

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ACKNOWLEDGEMENTS

This guide has been revised by staff of Portland Public Schools as part of a funded project to develop a model program in electricity and electronics. Special appreciation is extended to Carol Matarazzo, Project Director, and the Portland staff members that were involved in the initial survey efforts; to the representatives of business, industry and labor that assisted in making it a true partnership effort; and to school administrators and counselors that participated as members of the project steering committee.

The instructional content of this guide reflects many hours of work by Bill Irgens, Benson High School and George McElmury of Cleveland High School. Their continuous involvement has resulted in a curriculum guide that brings the needs of employers into an instructional format that can be delivered to students in Portlands' secondary schools. Oregon secondary schools will benefit from the excellent curriculum units that were developed beyond the scope of this cluster guide. Bill and George have expressed a willingness to share curriculum units for exploration and preparation training in electricity and electronics with other schools in Oregon.

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INTRODUCTION

OVERVIEW

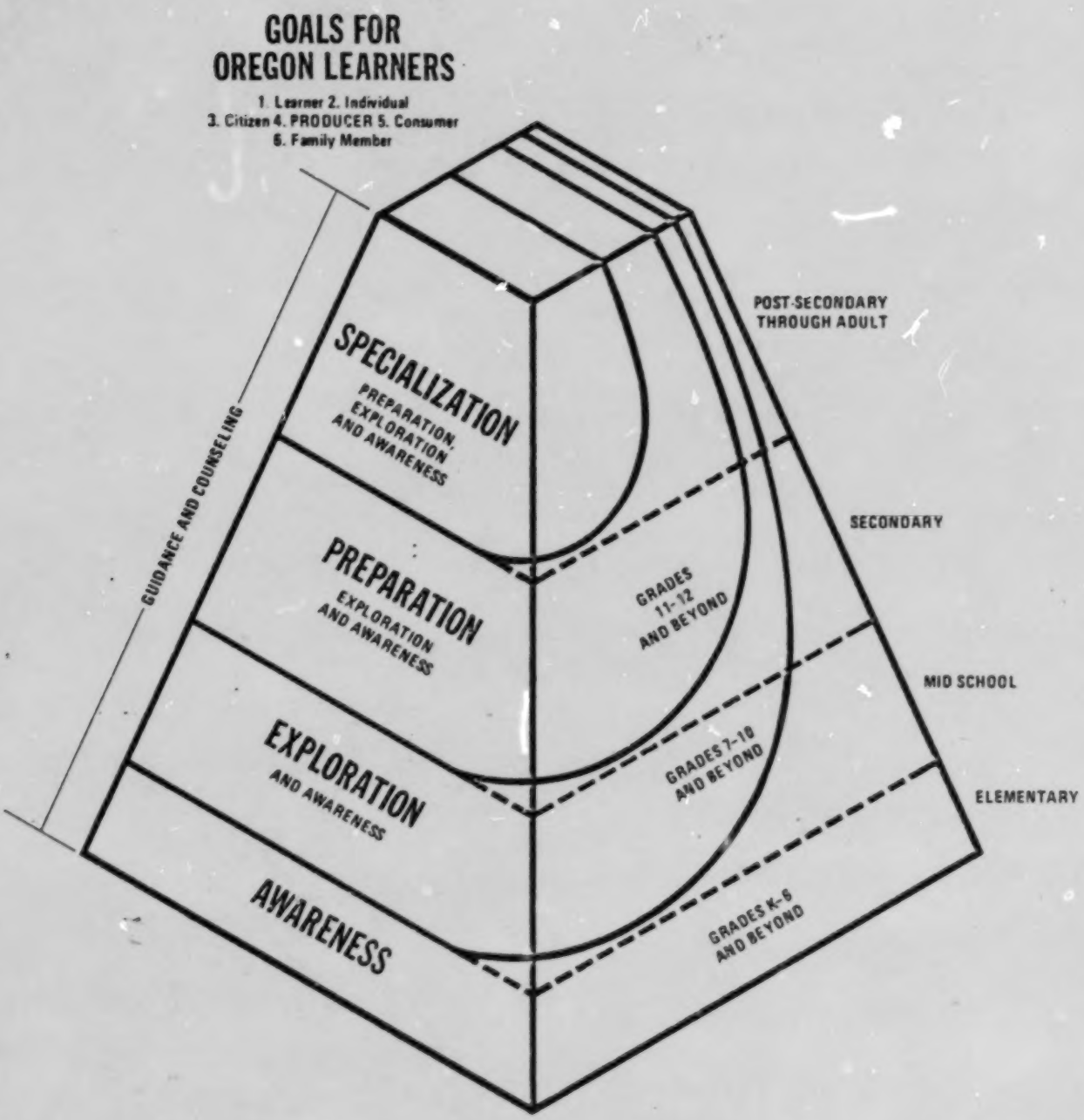
This guide is divided into six sections. The first one introduces vocational and career education in general and electrical occupation education in particular. It provides definitions of commonly used terms and guidelines for establishing acceptable secondary vocational programs. The text then focuses on a small but representative sample of electrical occupations. These are analyzed in terms of labor market trends and common skill requirements, from the student's point of view as well as the teacher's.

The third section of this guide begins by discussing the electrical cluster in terms of goal-based planning and then the cluster's main objective. After emphasizing the need for individualized instruction, the section offers suggestions for an electrical occupation cluster curriculum. After providing guidelines for establishing a high school cluster program, the text gives ideas for both core and elective courses.

The fourth section offers program goals, course goals and learning activities for nine phases of the career education process: safety, technical communications, mathematical calculations, tools and equipment, tests and measurements, assembly, maintenance and repair, electrical/electronic theory, human relations and careeers.

The fifth section discusses the need for assessment and suggests a number of criteria by which it may be carried out.

The appendices comprise the sixth section. See the table of contents for a complete listing of material included.



CAREER AND VOCATIONAL EDUCATION
IN OREGON

DEFINITIONS OF TERMS

Behavioral Objective. Is basically a performance indicator only with a criterion added (how well the student must do). Example: Given a list of ten colors and types of clothing, the student will identify a minimum of five each which are considered most safe for pedestrian use in various kinds of weather and illumination.

Career Awareness. Education which provides career growth opportunities as they relate to the six life roles, which develops an understanding of the world of work, which fosters a wholesome attitude toward self, work and society and which develops decision-making skills needed to make appropriate decisions for future career exploration. Other levels of instruction include exploration, preparation and specialization. Guidance and counseling are provided at each level.

Career Education. That education which links learning activities with jobs along the entire range of skills from the subtechnical ones to the professional skills. It is an integral part of the total educational program.

Career Analysis. A process of (a) grouping related jobs into families of occupations, (b) identifying key occupations, (c) analyzing job descriptions, (d) identifying performance requirements in the key occupations.

Cluster Curriculum. A curriculum which is based on related jobs grouped into a family of occupations and which emphasizes competencies derived from common tasks.

Competency. A demonstrated ability to perform a function representative of a group of similar tasks. Usually contains a performance verb and is more specific than a goal. Example: Distinguish between safe and unsafe apparel for pedestrian travel.

Concept. A major emphasis area identified for purposes of more effectively organizing curricula development efforts. Example: Building Construction Techniques.

Exploration. Provide students with opportunities to better understand themselves and the knowledge, skills, technical requirements, working conditions and political and social realities of each of the career fields that interest them.

Goals. A broad statement of instructional intent. May use such words as understand, know, appreciate, etc. Example: Student will be able to function as responsible citizens when participating in traffic as pedestrians.

Graduation Requirements. The State Board of Education adopted new minimum requirements for graduation in September 1972. In career development, each student should demonstrate competencies in the following areas: 1. good work habits, 2. a positive attitude toward work, 3. an ability to maintain good interpersonal relationships, 4. the ability to make appropriate career decisions, and 5. the ability to demonstrate the competencies required to function effectively in a chosen career.

Industrial Education. A general term applying to industrial related education, including Industrial Arts, Vocational Industrial (Trade and Industrial), and Technical Education.

Instructional Analysis. A process of (a) grouping knowledge and skills, (b) identifying expected student behaviors, (c) organizing knowledge requirements, (d) organizing classroom activities, (e) determining scope and sequence of curriculum.

Instructional Concept. A generalized idea of the composite skills and knowledge to be taught.

Key Occupations. Jobs in which 250 or more are employed and in which a five-year expansion/replacement need of 100 or more over a five-year period can be shown.

OREGON Employment Statistics (OES). The Oregon code system for reporting occupational data. OES codes have replaced D.O.T. classifications for all practical reporting purposes.

Performance Indicator. A description of student behavior which takes place within a prescribed setting (under certain conditions). Example: Given a list of colors and types of clothing, the student will identify those considered most safe for pedestrian use in various kinds of weather and illumination.

Preparation. Through the career cluster concept, students are given the opportunity to gain basic skills and knowledge related to a broad occupational area rather than to one occupation.

Related Occupations. Jobs in which 100 or more persons are employed in Oregon and among which similarities can be found.

Task. Any function a worker performs within a specific, continuous period of time and which results in a end product.

Task Inventory. A list of the duties and functions of a specific occupation which a worker performs in order to successfully hold the job.

Vocational Education. A component of career education which offers specific skill training in a wide variety of subtechnical, technical and subprofessional skills, which prepares individuals for gainful employment, and which may continue through skill upgrading or retraining for a new job.

World of Work. All existing job titles shown in the Dictionary of Occupational Titles.

PROVISIONS FOR APPROVAL

of

SECONDARY VOCATIONAL PROGRAMS

Secondary vocational cluster programs, special vocational programs, or alternative vocational programs shall be approved in accordance with policies and procedures established by the Oregon Department of Education.

CRITERIA FOR APPROVAL OF ALL SECONDARY VOCATIONAL EDUCATION INSTRUCTION

1. Vocational programs shall be sufficient in duration to develop the occupational skills and knowledge identified in the curriculum. Ten instructional hours per week for 36 weeks are required for cluster programs and special vocational programs, with the exception of alternative programs which have no minimum hourly instructional time requirements.

2. Instruction shall be based upon the skills and knowledge required in the occupation or occupational group upon which the program is based.

3. Vocational programs shall be based upon occupations which have significant demand for expansion and replacement.

4. Programs shall be open to all individuals who need vocational education, regardless of age, sex, race, ethnic origin, physical or mental handicaps, economic, academic, or other disadvantage.

5. Provision shall be made for the evaluation of vocational programs, based on how well stated objectives are met. Evaluation shall include appraisals from students, employers, and appropriate occupational advisory committees.

6. Instructors of vocational programs shall possess the occupational and educational competencies required in the vocational program area. As defined in Teacher Standards and Practices Commission regulations, appropriate certification for a given teaching assignment is required for vocational teachers at the secondary level.

7. Vocational programs shall be developed and conducted with the advice and assistance of an occupational advisory committee.

8. Vocational program curriculum materials shall avoid sex role and minority group stereotyping and bias.

9. Instruction shall be for occupations which do not require a baccalaureate or higher degree.

10. Students shall be provided with adequate instruction in safety practices related to a given occupation.

11. Vocational guidance shall be available to all students in vocational programs.

12. Placement and follow-up services should be provided for all program completers and early leavers.

13. Vocational education student organizations should be made an integral part of the instructional program.

14. Facilities, equipment, instructional aids, and supplies shall be of sufficient quantity and quality to allow students to meet curriculum objectives.

15. Appropriate written agreements or contracts shall be developed, with all available community resources utilized for student learning and occupational experience.

16. Close working relationships with community resources, especially business, industry, labor and other agencies, shall be maintained in the development, implementation, and operation of vocational programs, including cooperative work experience programs.

CRITERIA FOR APPROVAL OF VOCATIONAL CLUSTER PROGRAMS

Electrical/Electronics Cluster

1. The student shall be provided ten hours of instruction per week during each year of a state-approved program, for which a minimum of two units of credit is awarded. The requirement can be met through the following approach:

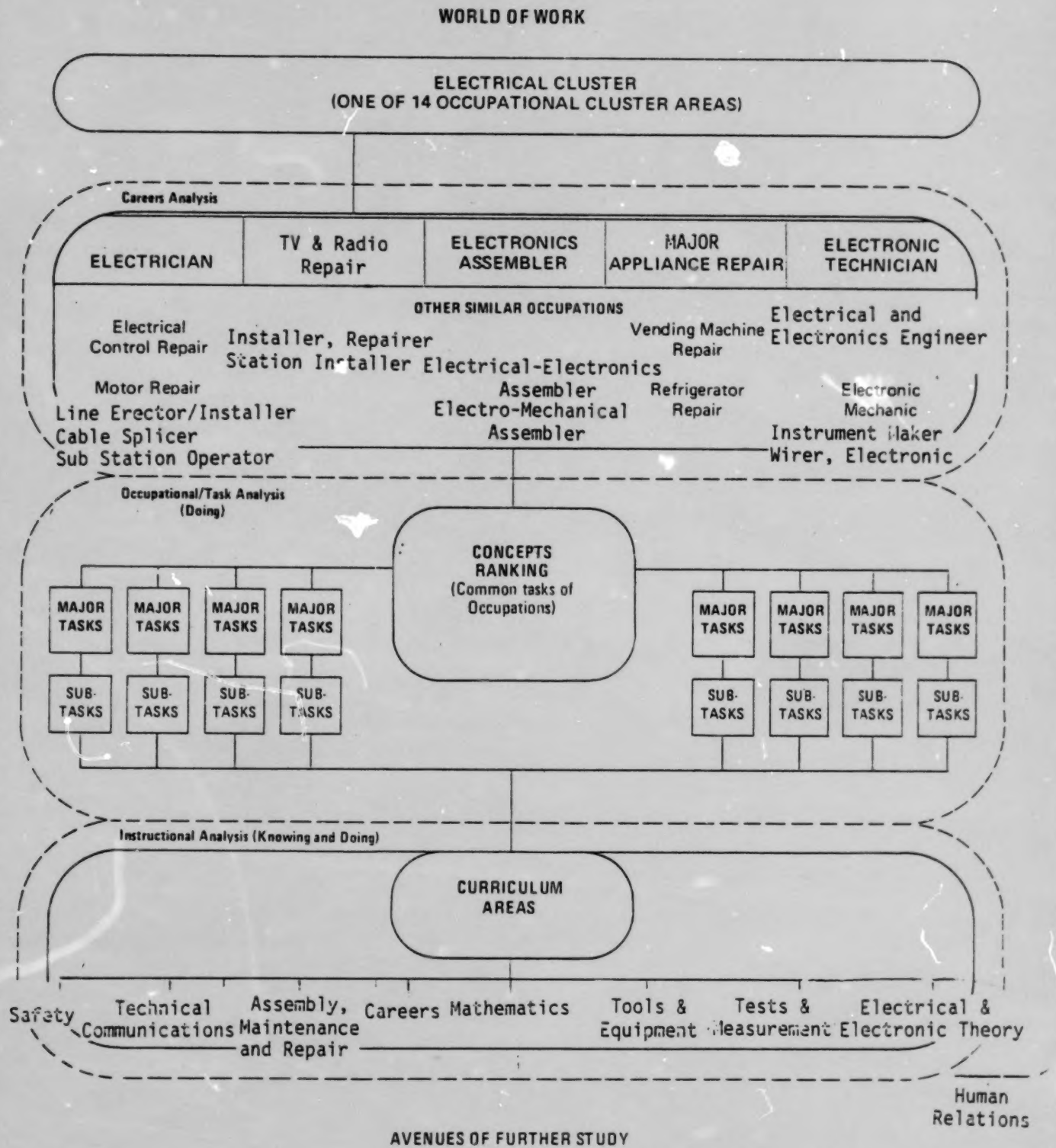
   -Two or more periods per day of instruction, in sequence.

2. Vocational Industrial Clubs of America (VICA) leadership and skills development activities should be an integral part of the instructional program, with a qualified vocational trade and industrial instructor serving as chapter adviser.

3. Cooperative work experience (paid) should be made an integral part of the program of instruction.

4. School-directed learning experiences should be offered which replicate actual electronics industry projects.

OCCUPATIONAL AND INSTRUCTIONAL ANALYSIS


WORLD OF WORK
ELECTRICAL CLUSTER
(ONE OF 14 OCCUPATIONAL CLUSTER AREAS)
Careers Analysis
ELECTRICIAN
TV & Radio Repair
ELECTRONICS ASSEMBLER
MAJOR APPLIANCE REPAIR
ELECTRONIC TECHNICIAN
OTHER SIMILAR OCCUPATIONS
Electrical Control Repair
Installer, Repairer
Station Installer
Vending Machine Repair
Electrical and Electronics Engineer
Motor Repair
Electrical-Electronics Assembler
Refrigerator Repair
Electronic Mechanic
Line Erector/Installer
Cable Splicer
Sub Station Operator
Electro-Mechanical Assembler
Instrument Maker
Wirer, Electronic
Occupational/Task Analysis (Doing)
CONCEPTS RANKING
(Common tasks of Occupations)
MAJOR TASKS
SUB-TASKS
Instructional Analysis (Knowing and Doing)
CURRICULUM AREAS
Safety
Technical Communications
Assembly, Maintenance and Repair
Careers
Mathematics
Tools & Equipment
Tests & Measurement
Electrical & Electronic Theory
Human Relations
AVENUES OF FURTHER STUDY
• PRIVATE SCHOOLS
• UNIVERSITY
• EMPLOYMENT
• APPRENTICESHIP
• COMMUNITY COLLEGE

OREGON MANPOWER DATA

O.E.S. No.	KEY OCCUPATIONS FOR ANALYSIS PROCESS	1983 EMP	1983 OPENINGS	O.E.S. No.	KEY OCCUPATIONS 250 EMPLOYED	1983 EMP	1983 OPENINGS	O.E.S. No.	RELATED OCCUPATIONS 100 or MORE EMPLOYMENT	1983 EMP	1983 OPENINGS
32004	Electrical and Electronic Technician	3852	194	21005	Electrical and Electronics Engineer	4364	252	55U82	Instrument Maker, Assembler	233	8
				51077	Electronics Mechanics	490	19	55R74	Wirer, Electronic	141	9
55B12	Electrician	5735	193	55B73	Line Erector/Installer Repairer	1813	55	55D01	Substation Operator	155	3
				55A93	Cable Splicer	572	16				
	Household Appliance Repairer	738	39		----------			55D73	Household Appliance Installer	126	9
51055	TV Service/Repairer Radio, Tape Recorder Repairer	674	35	55B59	Installer, Repairer	1246	30	51D51	Radio Mechanic	138	5
				55C89	Station Installer	501	13				
55U84	Electrical/Electronics Assembler	4597	241		----------				----------		
55U83	Electro-Mechanical Assembler	890	46		----------				----------		
	----------				(INDUSTRIAL ELECTRICITY/ ELECTRONICS)						
				55A55	Central Office Repairer	957	24	55B35	Frame Wirer	191	5
				55B53	Inspector	1109	70	55R82	Coil Winder	177	18
				55Q57	Testor	415	14				
				51020	Electric Motor Repairer	355	22	55B10	Electric Trace Switch Maintenance	136	14

TASK ANALYSIS FOR
DETERMINING COURSE CONTENT

ON-THE-JOB-TASKS	ELECTRICIAN	TV/RADIO/TAPE RECORDER REPAIRER	HOUSEHOLD APPLIANCE REPAIRER	ELECTRONIC TECHNICIAN	ELECTRONICS ASSEMBLER
1.0 SAFETY					
Practice accident prevention and safety	X	X	X	X	X
Apply first aid	X	X	X	X	X
2.0 TECHNICAL COMMUNICATIONS					
Read and interpret technical materials	X	X	X	X	X
Interpret and use terminology in speech and writing	X	X	X	X	X
Maintain written records and documents	X	X	X	X	X
Communicate through computer language				X	
Follow oral and written instructions	X	X	X	X	X
3.0 MATHEMATICS					
Use arithmetic functions	X	X	X	X	X
Use algebraic functions	X	X	X	X	
Use basic numbering systems	X	X	X	X	
Apply mathematics skills to electronic circuits	X	X	X	X	X
4.0 TOOLS AND EQUIPMENT					
Identify and use hand tools	X	X	X	X	X
Identify and use power tools	X	X	X	X	X

TASK ANALYSIS FOR
DETERMINING COURSE CONTENT

ON-THE-JOB-TASKS	ELECTRICIAN	TV/RADIO/TAPE RECORDER REPAIRER	HOUSEHOLD APPLIANCE REPAIRER	ELECTRONIC TECHNICIAN	ELECTRONICS ASSEMBLER
5.0 TESTING AND MEASURING					
Use and maintain testing and measuring equipment	X	X	X	X	X
Measure and test electrical circuits	X	X	X	X	X
6.0 THEORY					
Use basic theory of D.C. electricity	X	X	X	X	X
Use basic theory of A.C. electricity	X	X	X	X	X
Apply basic theories of electrical devices	X	X	X	X	X
Use the basic theories of electrical circuits	X	X	X	X	X
Identify electrical and electronic components	X	X	X	X	X
Use basic electricity and electronic concepts to identify circuits and test points	X	X	X	X	X
7.0 ASSEMBLY, MAINTENANCE AND REPAIR					
Maintain electronic and electro-mechanical systems	X	X	X	X	
Assemble/install electronic and electro-mechanical equipment	X	X	X	X	X
Repair electronic and electro-mechanical equipment	X	X	X	X	

TASK ANALYSIS FOR
DETERMINING COURSE CONTENT

ON-THE-JOB-TASKS	ELECTRICIAN	TV/RADIO/TAPE RECORDER REPAIRER	HOUSEHOLD APPLIANCE REPAIRER	ELECTRONIC TECHNICIAN	ELECTRONICS ASSEMBLER
8.0 HUMAN RELATIONS					
Work cooperatively with fellow employees, employers and customers	X	X	X	X	X
Demonstrate a positive attitude toward job	X	X	X	X	X
Accept leadership responsibilities at the work site	X	X	X	X	X
9.0 CAREERS					
Identify jobs and working conditions for electrical and electronics occupations	X	X	X	X	X
Define requirements and routes for entry into electrical/electronics occupations	X	X	X	X	X
Describe career ladders for advancement	X	X	X	X	X
Use appropriate job search techniques	X	X	X	X	X
Understand entrepreneurship opportunities in electricity and electronics	X	X	X	X	X

ELECTRICAL OCCUPATIONS CLUSTER ORGANIZATION AND IMPLEMENTATION

GOAL-BASED PLANNING FOR THE ELECTRICAL CLUSTER

Goals are guideposts. They serve to give purpose and direction to a planning activity. Goals provide a common language for discussing the merits of various activities as those activities are carried out.

In the electrical cluster, just as in any other instructional program offered by an educational system, a sense of purpose and direction is essential to good planning. But what are these purposes and directions? Where do they come from? Why should the electrical cluster teacher be concerned? These are questions to be answered before effective planning of an electrical cluster curriculum can proceed.

Each teacher must realize that planning an electrical cluster curriculum cannot begin and end only in a given classroom. It needs to be done with a sense of similar planning in other classrooms and districts within the state.

The goals, goal setting, and competency identification activities the Oregon Department of Education prescribes provide districts a common reference for the planning process. In goal-based planning, teachers must consider four goals: state goals for Oregon learners, district goals, program goals, course goals. They must also consider student competency and state defined competency areas.

State Goals answer the question: What does the Department of Education think a student should get out of public schooling anywhere in Oregon?

District Goals answer the question: What do the local community and its schools think a student ought to get out of local schooling and how is that to relate to State Goals?

Program Goals answer the question: What do the local curriculum planners and electrical cluster teachers think a student out to get out of the electrical cluster and how is that to relate to District Goals?

Course Goals (and Unit Goals—Elementary) answer the question: What do the electrical cluster teachers think a student ought to get out of technical communications, for instance, and how is that to relate to Program Goals?

State Competency Areas answer the question: What does the Department of Education believe to be the critical areas in which students must demonstrate competence for graduation?

Competency, then, answers the question: What has students demonstrated they can do with what they have learned?

The relationships among each of these components are illustrated on the following page. Note that competencies may be stated broadly (as with district goals) or specifically (as with course goals) depending on how extensive the district desires a particular demonstration to be. The sample competency in the figure is shown as being an intended outcome of both district *and* program level goal planning. Other competencies could be shown as the intended outcomes of district or course goal-level planning (broken lines).*

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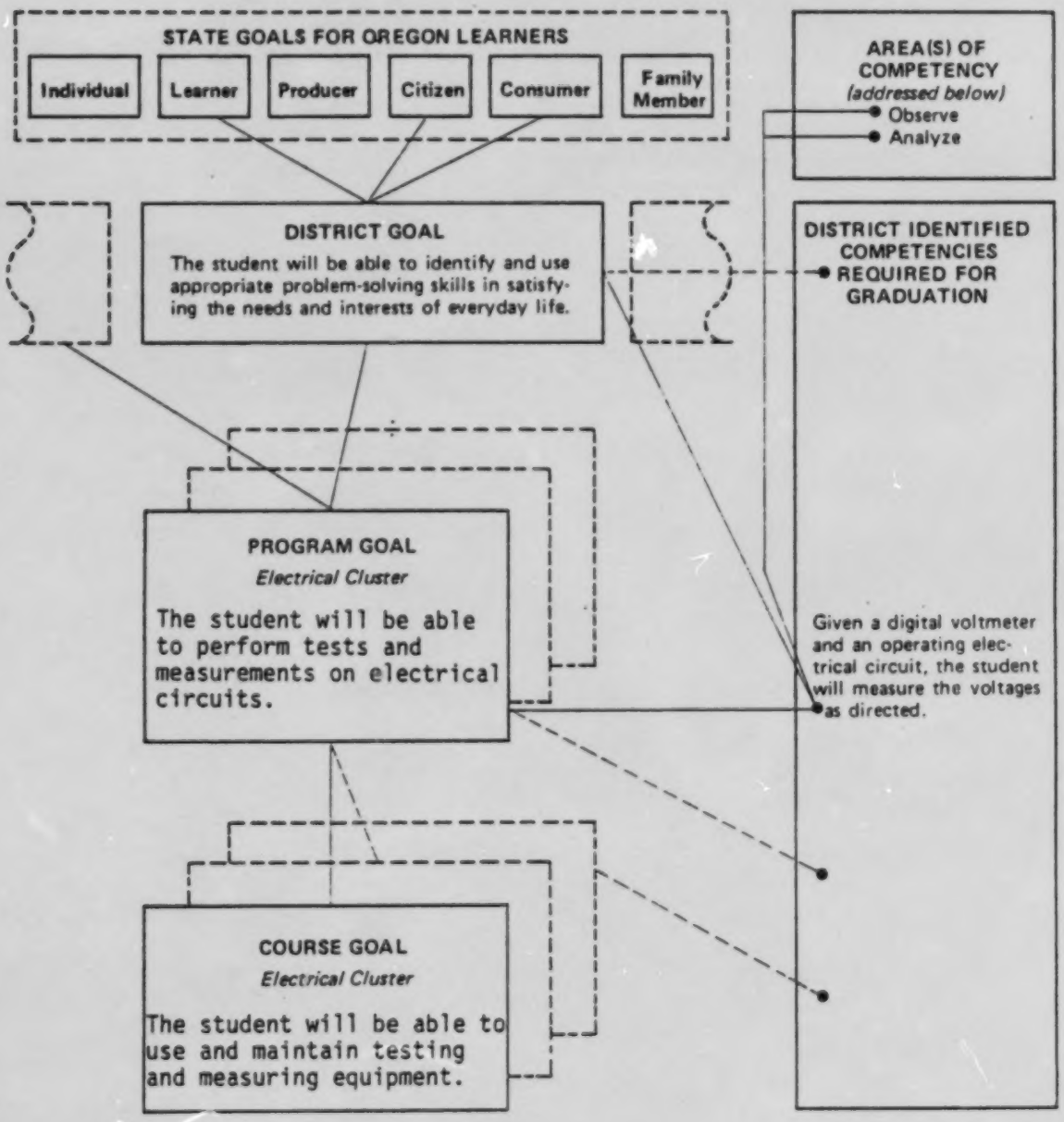
* All goals may not be competencies, but all competencies may be used as goals. Goals are often written about the *acquisition and application* of knowledge and skills. Competencies are ALWAYS written about the *application* of knowledge and skills.

The system of goals and competencies just described* is designed to help the teacher and program specialist plan their own electrical cluster program. It promotes a framework for planning that may be shared by all those doing similar planning. It helps in planning for individual student goals and interests, to be done within the limits of available resources. It should not be used to limit what is planned. Rather it should be used as a starting place.

SAMPLE COMPLEMENTARY GOALS & COMPETENCIES


STATE GOALS FOR OREGON LEARNERS
Individual
Learner
Producer
Citizen
Consumer
Family Member
AREA(S) OF COMPETENCY
(addressed below)
Observe
Analyze
DISTRICT GOAL
The student will be able to identify and use appropriate problem-solving skills in satisfying the needs and interests of everyday life.
DISTRICT IDENTIFIED COMPETENCIES REQUIRED FOR GRADUATION
PROGRAM GOAL
Electrical Cluster
The student will be able to perform tests and measurements on electrical circuits.
Given a digital voltmeter and an operating electrical circuit, the student will measure the voltages as directed.
COURSE GOAL
Electrical Cluster
The student will be able to use and maintain testing and measuring equipment.

* For more information on goal-based planning, see Oregon Department of Education publications *Elementary-Secondary Guide for Oregon Schools: Part II, Suggestions* (1977) and *Planning the Education of Oregon Learners: Setting Goals* (1975).

OBJECTIVE OF THE ELECTRICAL CLUSTER

The objective of the electrical cluster is to provide opportunities for individuals to acquire a broad conceptual knowledge and entry-level skills in:

1. electrical safety practices
2. technical communications
3. mathematical calculations
4. use and maintenance of tools and equipment
5. tests and measurements on electrical circuits
6. basic electrical and electronic theory
7. maintenance, assembly and repair of electro-mechanical equipment
8. human relations skills
9. career options, career ladders and job search techniques

While these skills are considered basic to the electrical cluster, supplementary objectives should be developed by teachers for various age and grade levels.

INDIVIDUALIZED INSTRUCTION

By its very nature, the cluster concept demands the use of some method of individualized instruction. No matter what method is used, it should be based on student performance that is measurable.

The use of an individualized learning system requires a reorientation of the instructor's role. The instructor becomes a counselor and a director to help guide the student through the system which he or she established. The instructor answers questions on an individual basis. He or she occasionally lectures to the whole class. He or she holds small-group seminars and discussions. Maintaining a record of the student's progress is also important.

An in-service program will be needed to orient the instructor to his or her new role and to the proper ways of implementing and directing the individualized learning system.

Any individualized system should be able to do the following:

1. Give credit for previously learned and demonstrated skills,
2. Allow the student to pause for remedial assistance, and then resume his/her studies,
3. Inform each student of the specific behavioral outcomes for which he/she will be responsible,
4. Allow the student to progress individually,
5. Monitor each student's progress.

ELECTRICAL CLUSTER CURRICULUM

The guide which follows is designed to provide qualified teachers with "educational specifications" for specific knowledge and skills that will qualify students for *entry-level employment* in the electrical occupations listed in the "World of Work" chart. It must be remembered that in the apprenticeable trades an apprenticeship of two to four years will follow upon employment. The teacher will have to organize the specifications to assure students the training that will fit their individual needs and desires.

An electrical program should encompass:

Occupational exploratory experiences in grades seven through ten. They are of prime importance to students in developing career goals and plans. Courses in industrial arts, general business, industrial English, mathematics, and science will provide valuable experiences leading to the electrical cluster in grades 11 and 12.

Occupational guidance. Helping students to learn more about themselves and to choose an occupational field which will offer them both challenge and self-fulfillment is the heart of a successful occupational education program.

Electrical cluster courses in grades 11 and 12. These courses should be allocated a segment of time approximating two periods per day or ten hours per week. This amount of time is minimal for the study and experience required to achieve the curriculum objectives. The education specifications for these courses begin on page 24. *The following major areas appear in these specifications, but they are not presented in any required sequence:*

1. Appropriate use of technical communications,
2. Proper use of test equipment,
3. Electro-mechanical construction, installation, maintainance and repair,
4. Basic electrical theory and related math,
5. Personal development and leadership skills.

Allied supporting elective courses in grades 11 and 12. The student should be able to choose supplemental learning experiences which will sharpen his/her particular interests and talents and help him/her attain occupational objectives. A list of recommended allied supporting elective courses is suggested on page 25.

Cooperative work experience programs. These should be approved by the Division of Instructional Support, Career Education, but could make up a portion of the required time blocks. A Department of Education publication entitled *Work Experience Manual* will supply details on establishing such a program. A suggested electrical cluster curriculum plan is presented on page 24.

The Department of Education recognizes that each local school district will encounter unique problems in scheduling when undertaking the implementation of the secondary occupational cluster program. The suggested time blocks are governed by the State Plan for Vocational Education, and within those limitations are flexible and can be adapted to the needs of the local school district.

A SUGGESTED CURRICULUM PLAN
ELECTRICAL CLUSTER CURRICULUM

Period	Grades 7 and 8	Grade 9	Grade 10	Grade 11	Grade 12
I	Social Studies	Communication Skills	Communication Skills	Communication Skills	Communication Skills
II	Language Arts	Mathematics	Mathematics II or Algebra	U.S. History	Humanities Elective
III	Mathematics	Health and Physical Education	Health and Physical Education	Health and Physical Education	Applied Physics, Business Law, Bookkeeping, Economics, Speech, Data Processing
IV	Health and Physical Education	Science	Science	*Allied Supporting Elective (Applied Math)	*Allied Supporting Elective (Applied Math)
V	Science, General Music	**Industrial Arts (Exploratory)	****Industrial Arts (Drafting) (Basic Electricity–Electronics)	Electrical Cluster Course	Electrical Cluster Course
VI	Arts, Homemaking, **Industrial Arts	General Business (Exploratory) Careers Orientation		***Communications	

*NOTE: See page 25 for a complete listing of allied supporting courses.
**Functions of Industry–Materials and Processes, Power and Mechanics, Electricity/Electronics, Graphics/Communications.
***Includes basic entry knowledge and skills related to mathematics and verbal and nonverbal communication identified within the electrical industry. Taught as an interrelated part of the total cluster curriculum.
****Semester offerings.

Occupational Specialty Courses

Curriculum Electives

Required Courses

SUGGESTED ALLIED SUPPORTING COURSES

The following list of allied supporting courses is recommended to students planning to enter, or those already enrolled in, the electrical cluster curriculum.

Industrial arts programs provide many of the opportunities mentioned in the course descriptions, although course titles do not remain constant. This does not limit their scope or effectiveness in supplying learning experiences in these areas. In most cases, the existing program, with only slight modification of content, will provide the experiences suggested in the following course descriptions.

Courses generally found in the high school curriculum such as Basic Economics, Speech, Technical Writing, General Science, Mathematics through Trigonometry, etc., also are supporting courses and should be considered when choosing electives.

The student must consider all courses available and discuss various alternatives with his parents, school counselors, and advisors. This will help him choose an educational program with realistic career-oriented experiences and objectives.

Basic Metalworking and Machine Tools

A course designed to provide learning experiences dealing with the fundamentals of basic metals and machine tools used in industry. Included in the laboratory course will be the theory and application of machine tools to forming and shaping of metals most commonly found and used in industry to fabricate machine parts and assemble components. During the course, the student will learn the basic operation of the drill press, lathe, shaper, and grinder. Some basic metallurgy will also be considered for discussion and experimentation.

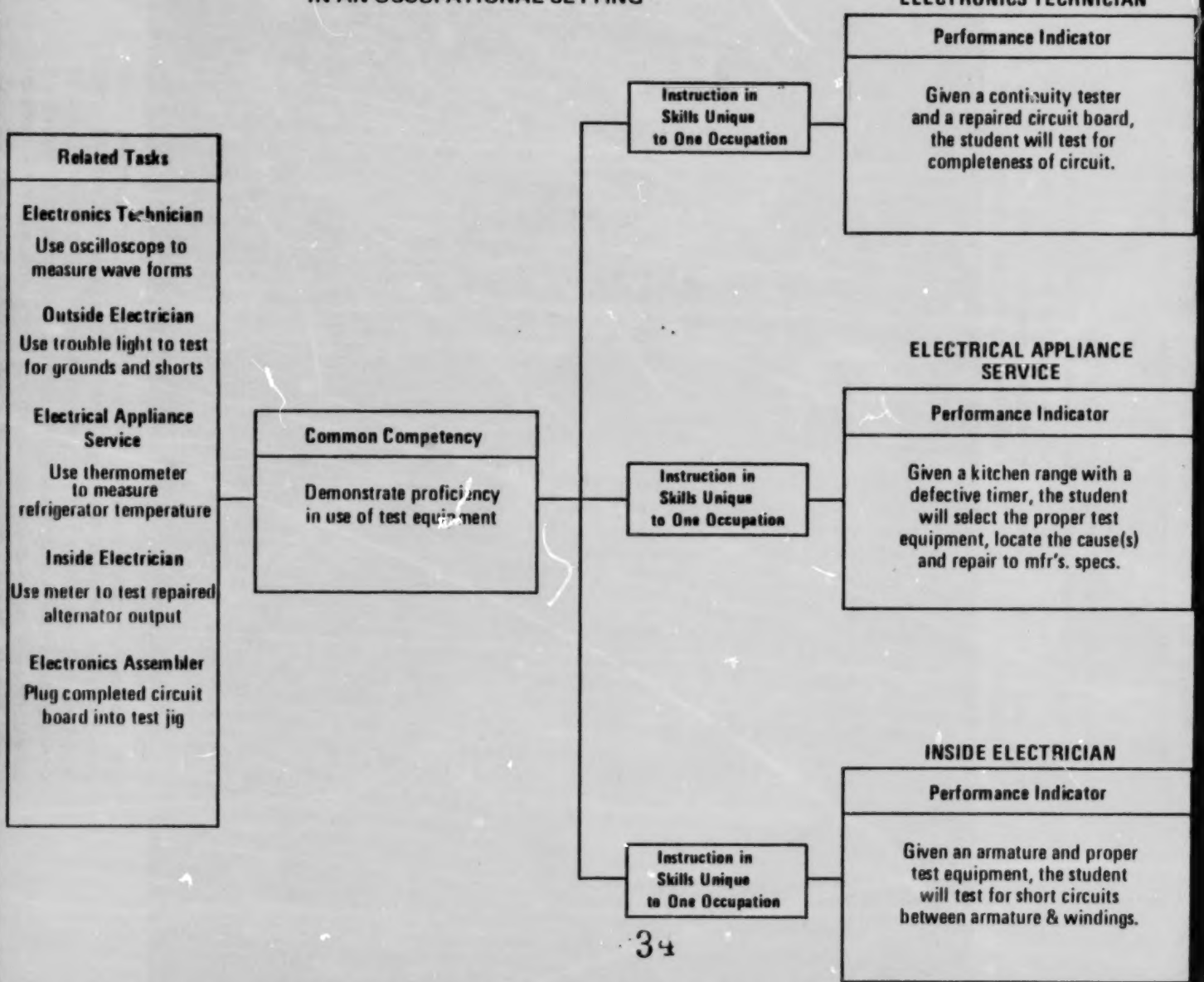
Welding Fundamentals

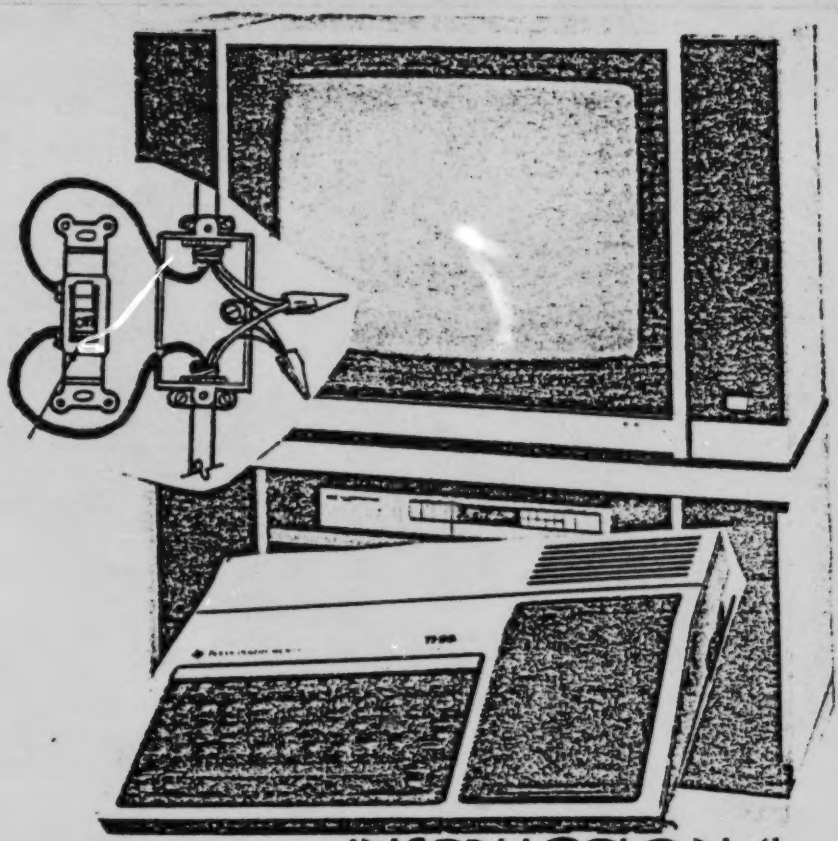
A lecture, demonstration, and laboratory course covering the fundamentals of electrical welding, soldering, brazing of ferrous and nonferrous metals. Technical information is correlated with manipulative practice to provide an opportunity for the student to become familiar with methods in fabrications used in repair and maintenance.

Graphic Communications

A course designed to introduce the student to the area of graphic communications, i.e., the methods and mechanics by which individuals in modern industry communicate ideas and concepts. Included in the course are instruction and practice in principles of visualization, oral communication, technical sketching, basic drafting, blueprint reading, shop processes, specification and tolerancing, photography and printing. Specific technical information is correlated with laboratory experiences to provide an opportunity for students to develop a fundamental concept of methods by which human beings communicate ideas through schematic drawings, blueprints, technical service manuals and conversations.

RELATIONSHIP OF COMMON AND UNIQUE SKILLS IN AN OCCUPATIONAL SETTING

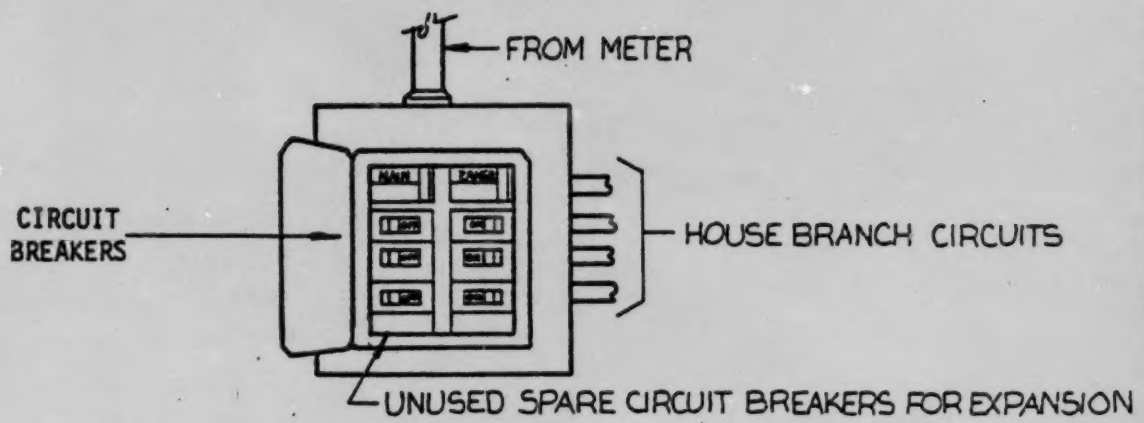

Related Tasks
Electronics Technician
Use oscilloscope to measure wave forms
Outside Electrician
Use trouble light to test for grounds and shorts
Electrical Appliance Service
Use thermometer to measure refrigerator temperature
Inside Electrician
Use meter to test repaired alternator output
Electronics Assembler
Plug completed circuit board into test jig
Common Competency
Demonstrate proficiency in use of test equipment
Instruction in Skills Unique to One Occupation
Instruction in Skills Unique to One Occupation
Instruction in Skills Unique to One Occupation
ELECTRONICS TECHNICIAN
Performance Indicator
Given a continuity tester and a repaired circuit board, the student will test for completeness of circuit.
ELECTRICAL APPLIANCE SERVICE
Performance Indicator
Given a kitchen range with a defective timer, the student will select the proper test equipment, locate the cause(s) and repair to mfr's. specs.
INSIDE ELECTRICIAN
Performance Indicator
Given an armature and proper test equipment, the student will test for short circuits between armature & windings.



INSTRUCTIONAL EMPHASIS AREAS

PROGRAM GOALS

1.0 Work safely with electricity.
2.0 Use appropriate technical communications.
3.0 Perform mathematical calculations related to electricity and electronics.
4.0 Use and maintain tools and equipment.
5.0 Perform tests and measurements on electrical circuits.
6.0 Use basic electrical and electronic theory.
7.0 Perform skills and processes involved in maintenance, assembly and repair of electro-mechanical equipment.
8.0 Use human relations skills that are appropriate to job success.
9.0 Understand career options, career ladders and job search techniques.



SAFETY

COURSE GOALS

1.1 Practice accident prevention and safety.
1.2 Apply first aid.

Program Goal: 1.0 The student will be able to work safely with electricity.

Course Goal:

1.1 The student will be able to practice accident prevention and safety.

- Electricity
- Power tools and equipment
- Hand tools
- Housekeeping
- Personal protection gear
- Use of lockout systems

Activities:

Have students complete instructional module.

EL-BE-07 Safety and Electricity

Conduct safety demonstrations on tools, equipment, protective gear and lockout systems.

Assembler Modules for Additional References

EA 03 Safety I
EA 04 Safety II

Program Goal: 1.0 The student will be able to work safely with electricity.

Course Goal:	Activities:
1.2 The student will be able to apply First Aid.	Encourage and/or require students to complete the multi-media First Aid class provided through the Red Cross and other local agencies. Demonstrate First Aid for electrical shock victims.

TECHNICAL COMMUNICATIONS

COURSE GOALS

2.1 Read and interpret technical materials used in electricity and electronics.

2.2 Interpret and use terminology of electrical and electronics occupations in speech and writing.

2.3 Maintain written records and documents.

2.4 Communicate through computer language.

2.5 Follow oral and written instructions.

Program Goal: 2.0 The student will be able to use appropriate technical communications.

Course Goal:

2.1 The student will be able to read and interpret technical materials used in electricity and electronics.

- Blueprints
- Drawings
- Specifications
- Sketches
- Schematic diagrams
- Abbreviations
- Technical reports
- Equipment manuals
- Graphs
- Charts

Activities:

Have students complete instructional module.

EL-BE-5.9 Glossary of Symbols

Make assignments in reading and interpreting diagrams, schematics, blueprints, drawings and technical manuals.

Have students make a glossary of abbreviations for their notebooks.

Have students write technical reports of circuit operation, faults, etc.

Have students fill out reports by interpreting data from graphs, charts, manuals, etc.

Program Goal: 2.0 The student will be able to use appropriate technical communications.

Course Goal:

2.2 The student will be able to interpret and use terminology of electrical and electronics occupations in speech and writing.

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Activities:

Have students complete assignments that utilize the terminology found in the instructional module.

EL-BE-58 Glossary of Key Words

Have students give technical reports (oral) that utilize electrical terminology.

Have students prepare technical reports (written) that utilize electrical terminology.

45

Program Goal: 2.0 The student will be able to use appropriate technical communications.

Course Goal:

2.3 The student will be able to maintain written records and documents.

- Cost records
- Materials records
- Inventories
- Safety records
- Job/time worksheets
- Business forms

Activities:

Make assignments that require students to fill out records, inventories, job sheets and other business forms that are common to the electrical and electronic trades.

Utilize projects of the VICA Chapter to teach record-keeping to students.

Program Goal: 2.0 The student will be able to use appropriate technical communications.

Course Goal:

2.4 The student will be able to communicate through computer language.

48

Activities:

Have students complete instructional module.

EL-BE-56 Computer Overview

Make assignments on microcomputers (at school) that require students to keyboard input into the computer and obtain output through the use of software or their own programs.

Have students work cooperatively with school computer center to improve computer literacy.

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Program Goal: 2.0 The student will be able to use appropriate technical communications.

Course Goal:

2.5 The student will be able to follow oral and written directions.

50

Activities:

Make assignments both oral and written to have students:

- **look up schematics and service data,**
- **take measurements, data, etc. from equipment,**
- **interpret information from service reports written or orally presented by other students.**

51

$P = I \times E$ or $P = IE$

also

$P = E \times I$ or $P = EI$

$E = \frac{P}{I}$

$I = \frac{P}{E}$

Explanation: Watt's Law
P = power (watts)
I = current (amperes)
E = voltage (volts)*

MATHEMATICS

COURSE GOALS

3.1 Use the arithmetic functions to calculate electrical circuit characteristics. (Hand and calculator)

3.2 Use the basic algebraic functions to calculate electrical circuit characteristics.

3.3 Use basic numbering systems in making electrical and electronic calculations.

3.4 Apply mathematics skills to electronic circuits.

Program Goal: 3.0 The student will be able to perform mathematical calculations related to electricity and electronics.

Course Goal:

3.1 The student will be able to use the arithmetic functions to calculate electrical circuit characteristics. (Hand and calculator)

- Addition
- Subtraction
- Multiplication
- Division
- Fractions and decimals
- Percentages
- Ratio and proportion
- Metric conversions

Activities:

Have students complete instructional modules.

EL-BE-01 Calculator
EL-BE-09 Metric Prefixes

Assign other problem sets as appropriate.

Emphasize mathematics throughout all instructional activities of the program.

Assembler Packages for Additional Reference

EA 11 Hand Held Calculator
EA 12 Metric Prefixes

Program Goal: 3.0 The student will be able to perform mathematical calculations related to electricity and electronics.

Course Goal:

3.2 The student will be able to use the basic algebraic functions to calculate electrical circuit characteristics.

- Powers and roots
- Linear equations
- Exponents and radicals
- Logarithms
- Trigonometric functions
- Vectors

Activities:

Have students complete instructional module.

EL-BE-57 Scientific Notation

Assign other problem sets as appropriate.

Have the students compute mathematical problems involving D/C and A/C complex circuits.

Text
Have the students read and complete assignments in;

Basic Electronics, Grob. Chapters 16, 17, 26.

Program Goal: 3.0 The student will be able to perform mathematical calculations related to electricity and electronics.

Course Goal:

3.3 The student will be able to use basic numbering system in making electrical and electronic calculations.

- Boolean algebra
- Octal system
- Hexidecimal system
- Binary system

Activities:

Have students complete problem sets that require use of basic numbering systems.

Have students complete instructional module to review basic binary number systems in digital logic.

EL-BE-55 Digital Logic

Make additional assignments in texts:

Heath Manual, Book I:
Unit 1, Binary System
Unit 5, Boolean Algebra

Heath Manual - Microprocessor
Unit 1

Program Goal: 3.0 The student will be able to perform mathematical calculations related to electricity and electronics.

Course Goal:

3.4 The student will be able to apply mathematics skills to electronic circuits.

- Ohm's Law relationships
  - Voltage
  - Current
  - Resistance
  - Power
- DC resistive circuit analysis
  - Series
  - Parallel
  - Combination series parallel
  - Kirchhoff's Laws
  - Superposition Theorem
  - Thevenin's Theorem
  - Norton's Theorem
  - Node voltage method
- AC circuit fundamentals
  - RMS values
  - Peak and peak-to-peak values
  - Average values
- AC circuit analysis series and parallel
  - Phase angle values
  - Inductive reactance
  - Capacitive reactance
  - Impedence
  - Resonance
  - Polar notation
  - Rectangular notation
  - Transistor bias networks
  - Gain-decibel-power calculations
  - Op amp circuit calculations

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Activities:

Have students complete instructional module.

EL-BE-14 Equations

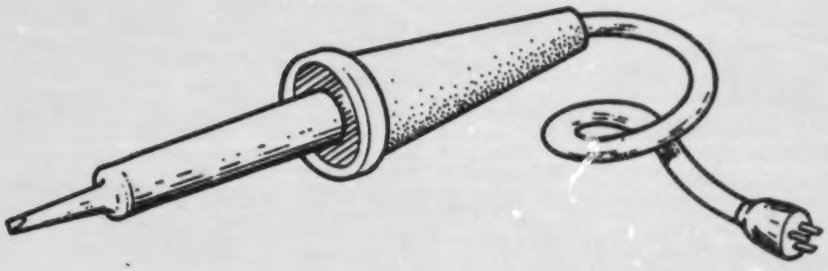
Have students calculate problem sets that utilize formulas in:

EL-BE-60 Glossary of Equations

Make additional assignments in text:

Basic Electronics - Grob. Chapters 1-8.

60



TOOLS AND EQUIPMENT

COURSE GOALS

4.1 Identify and use hand tools.

4.2 Identify and use power tools.

Program Goal: 4.0 The student will be able to use and maintain tools and equipment.

Course Goal:

4.1 The student will be able to identify and use hand tools.

- pliers (diagonal, long nose, slip joint)
- screw drivers (slotted, phillips)
- hammers (ball pein, mallet, claw)
- scribing tools (scribe, scratch awl)
- snips (regular, aviation, duck bill)
- dividers
- calipers (inside, outside)
- cold chisel
- punches (center, drift, pin punch, tube swage set)
- clamps (C clamps, hand screws)
- nut driver set
- hex wrench set
- spline wrench set
- files
- pop rivet gun
- hack saw
- scissors
- X-Acto knives
- squares (tri, combination, framing)
- wrenches (open end, adjustable, socket set)
- drills (twist)
- wire wrap
- wire strippers
- forecep clamps
- tweezers
- inspecting mirror
- crimp tool
- chassis punch
- reamer
- screw plate (tap and die)
- strain relief assembly tool

Activities:

Demonstrate correct and safe use of hand tools that are commonly used in working with electricity.

Make assignments on tool identification with flash cards, tool boards or tool displays.

Assign activities that require students to obtain "hands on" experience in the use of hand tools.

- **Make power supply chassis.**
- **Drill out and replace fasteners**

Have students complete instructional modules.

EL-EA-25 Wire Wrap I
EL-EA-26 Wire Wrap II

Assembler Packages for Additional References

EA 05	Introduction to using Basic Assembly Tools
EA 09	Hand Tools

Program Goal: 4.0 The student will be able to use and maintain tools and equipment.

Course Goal:

4.2 The student will be able to identify and use power tools.

- electric hand drill
- soldering irons
- wire wrap (power)
- Vibro-marker
- drill press
- grinder
- Rotex punch
- tap notcher
- squaring shear
- brake (box and pan)
- vacuum pump
- manifold gauge set (refrigeration)
- tubing cutter
- conduit bender
- coil winder
- Charge-all (refrigeration)
- propane torch
- scale 0-10 lbs.
- saber saw
- jig saw

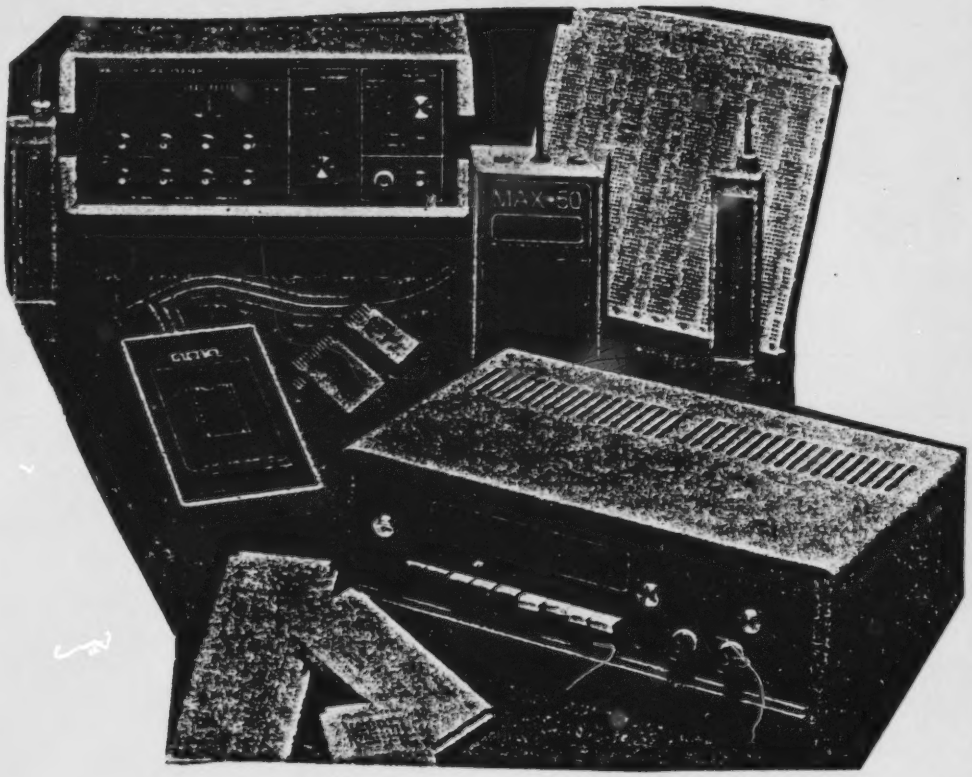
Activities:

Demonstrate correct and safe use of power tools.

Have students use power tools under the close supervision of instructor until they can pass a safety check on each tool.

Provide students with opportunity for "hands on" experience with power tools through projects and laboratory assignments.

Administer safety checks to students as the need is known.



TESTING AND MEASURING

COURSE GOALS

5.1 Use and maintain testing and measuring equipment.

5.2 Measure and test electrical circuits.

Program Goal: 5.0 The student will be able to perform tests and measurements on electrical circuits.

Course Goal:

5.1 The student will be able to use and maintain testing and measuring equipment.

- Thermometer
- Power converter
- Energy storage cells
- VOM VTVM DVM
- Oscilloscope
- Pulse generator
- Signal generator AF-RF
- Regulated power supply
- Ohmmeter
- Ammeter
- Digital counter
- Frequency counter
- Logic probe
- Transistor curve tracer
- Transistor tester
- Variac
- RC bridge

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Activities:

Have students complete instructional modules.

EL-BE-12 Reading Scales
EL-BE-13 Using a VOM
EL-BE-24 Oscilloscope Operation

Demonstrate other testing and measuring equipment to students.

Have students complete laboratory assignments on testing and measuring equipment.

EL-BE-00-B Instructor's Project Guide

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Program Goal: 5.0 The student will be able to perform tests and measurements on electrical circuits.

Course Goal:

5.2 The student will be able to measure and test electrical circuits.

- Voltage, current and resistance measurements
- Rise and fall times
- Inductance and capacitance L & C
- Frequency
- Time duration
- Watt-hour meter
- Logic states
- Distortion
- Transistor-diode measurements
- Integrated circuits
- Temperature

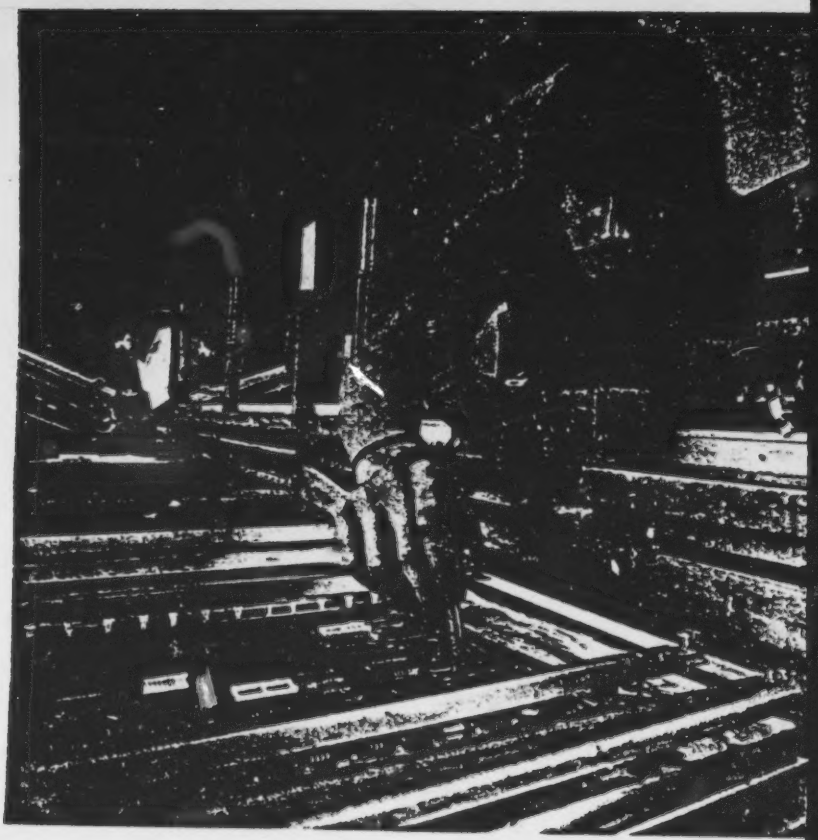
Activities:

Organize laboratory assignments that require students to test and measure electrical circuits.

Utilize "live" projects and equipment in test and measurements to add relevancy to the applications of electrical theory.

Examples of tests and circuits:

Test		Circuit
Transistor-Diode	-	Curve Tracer
Resistive-Inductive-Capacative	-	Time Constants
Temperature	-	Termistor-Thermocouple Meters
Frequency	-	Frequency Counters
etc.		etc.



ELECTRICAL/ELECTRONIC
THEORY

COURSE GOALS

6.1 Use the basic theories of D.C. electricity.

6.2 Use the basic theories of A.C. electricity.

6.3 Apply the basic theories of electrical devices.

6.4 Use the basic theories of electrical circuits.

6.5 Identify electrical and electronic components.

6.6 Use basic electricity and electronics concepts to identify circuits and test points.

Program Goal: 6.0 The student will be able to use basic electrical and electronic theory.

Course Goal:

6.1 The student will be able to use the basic theories of DC electricity.

- Electron theory
- Voltage sources
- Current flow
- Insulators
- Conductors
- Resistance
- Ohm's Law
- Power
- Series circuits
- Parallel circuits
- Series-parallel circuits
- Voltage divider
- Kirchhoff's Law
- Network analysis
- Electromagnetic induction
- Capacitance in DC circuits
- Magnetism
- RL and RC time constants

Activities:

Have students complete instructional modules.

EL-BE-02 Basics of Energy
EL-BE-03 Atomic Theory
EL-BE-04 Electrical Conducting
EL-BE-05 Basics of Direct Current
EL-BE-08 Voltage Sources
EL-BE-11 Introduction to Circuits
EL-BE-15 Ohm's Law
EL-BE-16 Power and Watt's Law
EL-BE-17 Ohm's Law, Watt's Law and Efficiency
EL-BE-18 Kirchoff's Current Law
EL-BE-19 Kirchoff's Voltage Law
EL-BE-20 Series Resistive Circuits
EL-BE-21 Parallel Resistive Circuits
EL-BE-22 Series-Parallel Resistive Circuits
EL-BE-39 Capacitor Time Constants
EL-BE-45 Magnetism
EL-BE-46 Characteristics of Inductors
EL-BE-47 Types of Inductors
EL-BE-48 Inductors in D.C. Circuits
EL-BE-50 Mutual Inductance

Conduct demonstrations to promote understanding of theories.

Have students complete laboratory assignments appropriate to the modules.

EL-BE-00B Instructor's Project Guide

Program Goal: 6.0 The student will be able to use basic electrical and electronic theory.

Course Goal:

6.2 The student will be able to use the basic theories of AC electricity.

- AC sine wave generation
- AC characteristics (RMS, peak, peak-to-peak)
- Inductance in AC circuits
- Inductors in series and parallel
- Inductive reactance XL
- Transformers
- Electronic transducers
- Capacitance in AC circuits
- Capacitors in series and parallel
- Capacitive reactance (Xc)
- RCL circuits series and parallel
- Impedance (Z)
- Resonance
- Bandwidth and Q
- Series and parallel resonance
- Filters (low pass, high pass, band pass, band stop, notch)

Activities:

Have students complete instructional modules.

EL-BE-25	Basics of Alternating Current
EL-BE-26	Measuring Alternating Current with Oscilloscope
EL-BE-37	Capacitor Fundamentals
EL-BE-40	Capacitors in Series and in Parallel
EL-BE-41	Capacitors in A.C. Circuits
EL-BE-49	Inductors in A.C. Circuits
EL-BE-51	Power Transformers
EL-BE-52	Audio Transformers

Review:

EL-BE-46	Characteristics of Inductors
EL-BE-47	Types of Inductors
EL-BE-48	Inductors in DC Circuits
EL-BE-50	Mutual Inductance

Conduct demonstrations to promote understanding of theories.

Have students complete laboratory assignments appropriate to the modules.

EL-BE-00-B Instructor's Project Guide

Make assignments in text:
Basic Electonics, Grob,
Chapters: 18-20, Inductance
21-23, Capacitance
27 , Resonance
28 , Filters

Program Goal: 6.0 The student will be able to use basic electrical and electronic theory.

Course Goal:

6.3 The student will be able to apply the basic theories of electrical devices.

- Diode characteristics
- Zener diodes
- TRIACs - DIACs
- Silicon controlled rectifiers (SCR)
- Unijunction transistor (UJT)
- Light emitting diode (LED)
- Photo cells
- Transistors (bipolar)
- Field Effect Transistors (FET)
- Op amps (linear, IC)
- Digital IC's
- CRT and Vidicons
- Thermocouples
- Transducers
- Vari-Caps
- Thermisters

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Activities:

Have students complete instructional modules.

EL-BE-27 Introduction to Diodes
EL-BE-28 Diodes in Circuits
EL-BE-29 Diodes as Rectifiers
EL-BE-30 Basic Transistors
EL-BE-31 Types of Transistors
EL-BE-32 Basic Transistor Operation
EL-BE-33 Transistor Current Relationships
EL-BE-34 Transistor Voltage Relationships
EL-BE-35 Transistors in D.C. Circuits
EL-BE-45 Op amps

Conduct demonstrations to promote understanding of theories.

Have students complete laboratory assignments appropriate to the modules.

Make assignments in texts:

Electronics - Schuler:
Chapter 7, FET's
Chapter 9, Op amps
Chapter 14, Electronic devices

Electricity and Electronics - Steinberg/Ford.
Page 414, Thermisters
Page 73-74, Thermocouples

EL-BE-00-B Instructor's Project Guide

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Program Goal: 6.0 The student will be able to use basic electrical and electronic theory.

Course Goal:

6.4 The student will be able to use the basic theories of electrical circuits.

- Rectification
- Filtering
- Regulation
- Overload protection
- Transistor biasing methods
- Amplifier configurations (CE, CC, CB)
- Small signal amplifiers
- Darlington pair
- Driver amplifier
- Power amplifier
- Class A amplifier chacteristics
- Class B amplifier characteristics
  Push - pull and complimentary pairs
- Class C amplifier characteristics
- Amplifier characteristics
- Amplifier gain (decibels)
- Negative feedback
- Distortion and noise
- Frequency domain
- Operational amplifier
- Differential amplifier
- Controlling gain
- Op amp applications
- Oscillators
- Comparator characteristics
- LC Oscillators
- RC Oscillators
- Modulation and demodulation
- Superheterodyne receiver
- Frequency modulation
- Counting in decimal and binary
- Binary to decimal conversion

Activities:

Have students complete instructional modules.

EL-BE-42 Transistor AC Amplifiers
EL-BE-43 Operational Amplifiers
EL-BE-44 Audio Power Amplifiers

Conduct demonstrations to promote understanding of theories.

Have students complete laboratory assignments appropriate to the modules.

EL-BE-00-B Instructor's Project Guide

Make assignments in texts:

Electronics, Schuler:
Chapter 9, Ap amp
Chapter 11, Oscillators
Chapter 12, Radio receivers
Chapter 6-8, Amplification

Heath - Digital Course
Book I, II

Do digital experiments using the Heath workbook and trainer.

Program Goal: 6.0 The student will be able to use basic electrical and electronic theory.

Course Goal:

6.4 (Continued)
- Decimal to binary conversion
- Binary codes
- Octal number system
- Hexadecimal system
- The AND gate
- The OR gate
- The inverter
- The NAND gate
- The NOR gate
- The Exclusive OR and NOR gate
- Boolean rules
- Minimizing logic expressions
- Using NAND/NOR gates
- Constructing circuits from Boolean expressions
- R-S flip-flop
- D flip-flop
- J-K flip-flop
- Down binary counter
- Up-down binary counter
- Synchronous counter
- BCD counter (Binary Code Deciman)
- Shift register applications
- Clocks
- Decodes
- Encodes
- Multiplexers
- Read only memory circuits (ROM)
- Random-access memory circuits (RAM)
- Programmable read only memory circuits (PROM)
- Digital to analog D/A converter
- Analog to digital A/D converter
- Microprocessor terms and conventions
- An elementary microcomputer
- Executing a program
- Addressing modes

Activities:

Program Goal: 6.0 The student will be able to use basic electrical and electronic theory.

Course Goal:

6.5 The student will be able to identify electrical and electronic components.

- Resistors
- Capacitors
- Inductors
- Speakers
- Microphones
- Tape heads
- IC package types
- Transistor package types
- Diode package types
- Switches
- Relays
- Motors (generation, alternation)
- Sensors
- Solenoids
- Transformers
- Lamps
- LED's
- Photo cells
- Thermistors
- Batteries
- Fuses (types)
- Thermostats

Activities:

Have students complete instructional modules.

EL-BE-23 Switches and Relays
EL-BE-38 Types of Capacitors
EL-BE-51 Power Transformers
EL-BE-52 Audio Transformers
EL-BE-53 Special Transformers

Construct displays of electrical and electronic components and have students identify various components.

Assembler Packages for Additional References

EA 06 Introduction to Basic Electronic Components
EA 16 Circuit Components I - Resistors
EA 17 Circuit Components II - Capacitors and Inductors (Coils)
EA 18 Circuit Components III - Semi-Conductors
EA 19 Circuit Components IV

Program Goal: 6.0 The student will be able to use basic electrical and electronic theory.

Course Goal:

6.6 The student will be able to use basic electricity and electronics concepts to identify circuits and test points.

- Voltage sources (test points)
- Ground reference points
- Series circuit
- Parallel circuit
- Power supply
- Voltage doubler
- Rectification methods
- Filters
- Regulation
- Pre-amplifiers (equalization networks)
- Coupling methods (RC, direct, transformer)
- Power amplifier (push-pull, complimentary)
- CB, CE, CC amplifiers
- Differential amplifier
- Op amp video
- Frequency compensation
- Oscillation RC and RL
- Multivibrators
- Basic logic gates (AND, NAND, OR, NOR, EXC OR)
- Timers
- Voltage test points recognition
- Motor starting

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Activities:

Have students complete instructional modules.

EL-BE-54 Digital Language
EL-BE-55 Digital Logic

Assign appropriate sections of other instructional modules.

Conduct demonstrations on identification of circuits and test points on old equipment and project demonstrators.

Review use of test equipment:
VOM
VTVM
Generators
Oscilloscope

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ASSEMBLY, MAINTENANCE
AND REPAIR

COURSE GOALS

7.1 Maintain electronic and electro-mechanical systems.

7.2 Assemble/install electronic and electro-mechanical equipment.

7.3 Repair electronic and electro-mechanical equipment.

Program Goal: 7.0 The student will be able to perform skills and processes involved in maintenance, assembly and repair of electro-mechanical equipment.

Course Goal:

7.1 The student will be able to maintain electronic and electro-mechanical systems.

- Calibration to manufacturer's specifications
- Testing sequences
- Lubrication of mechanical parts
- Cleaning and inspecting
- Sub-assembly removal and replacement

Activities:

Provide students with an orientation to the cleaning of parts and equipment.

Make laboratory assignments that involve procedures and concepts for:

- -cleaning
- -inspecting
- -testing
- -calibrating
- -lubricating
- -disassembling/reassembling
- -determining reparability
- -maintaining logs and records
- -troubleshooting
- -making safety inspections
- -replacing defective parts on printed circuit boards and projects.

Demonstrate maintenance procedures on basic test equipment (VTVM, oscilloscopes, etc.).

Assembler Packages for Additional Reference

EA 23 Quality Control, Locate and Identify Improper Solder Joints

Program Goal: 7.0 The student will be able to perform skills and processes involved in maintenance, assembly and repair of electro-mechanical equipment.

Course Goal:

7.2 The student will be able to assemble/install electronic and electromechanical equipment.

- Wire splices
- Wire size
- Color code
- Printed circuit board manufacture
- Component insertion into circuit boards
- Mechanical fasteners
- Techniques of soldering and desoldering
- Wire wrapping techniques
- Electric service box and distribution systems
- Electric conduit and fitting installation
- Grounding device installation
- Fixture and appliance installation
- Wire and cable connections
- Chassis construction
- Assembling mechanical systems

Activities:

Have students complete instructional modules.

EL-BE-06 Basics of Soldering
EL-BE-10 Color Codes and Resistors

Make laboratory assignments that require students to assemble/install electronic and electromechanical equipment.

Encourage student projects that involve assembly/ installation of various electrical components.

Make assignments in and teach students to use:

National Electric Code Book

Assembler Packages for Additional References

EA 07 Basic Parts Layout for Electronics Assemblers
EA 08 Introduction to Basic Soldering
EA 10 Mechanical Assembly
EA 13 Color Code
EA 14 Wire Preparation for Harness Making
EA 15 Wire Harness Making
EA 20 Care and Use of Soldering Tools
EA 21 Basic Soldering
EA 22 Precision Soldering

Program Goal: 7.0 The student will be able to perform skills and processes involved in maintenance, assembly and repair of electro-mechanical equipment.

Course Goal:

7.3 The student will be able to repair electronic and electromechanical equipment.

- Trouble shooting techniques
- Disassembly and assembly techniques
- Electronic component replacement
- Tool identification
- Proper use of test equipment
- Replacement of mechanical drive components
- Use of safety lock-out device on power panels or high voltage equipment

Activities:

Have students complete instructional module.

EL-BE-36 Troubleshooting D.C. Amplifiers

Set up simulations for students to practice troubleshooting.

Provide opportunities for students to troubleshoot and repair electro-mechanical equipment.

Provide procedure set ups for disassembly, maintenance, assembly and testint of simple electromechanical units such as turntable record changers, tape players, etc.

HUMAN RELATIONS

COURSE GOALS

8.1 Work cooperatively with fellow employees, employers and customers.

8.2 Demonstrate a positive attitude toward job.

8.3 Accept leadership responsibilities at the work site.

Program Goal:

8.0 The student will be able to use human relations skills that are appropriate to job success.

Course Goal:

8.1 The student will be able to work cooperatively with fellow employees, employers and customers.

- Follow orders
- Get along with others

Activities:

Conduct large group sessions to discuss the handling of problems in human relations.

Make assignments that require students to work together.

Provide individual help to students that are having problems in getting along with others.

Involve students in VICA activities that promote cooperation.

Have students complete LAP assignments.

Referenced LAP (IDEC) Packages

HUMAN RELATIONS
- LAP 11 Maintaining Self-Control
- LAP 12 Maintaining An Objective Point of View
- LAP 13 Accepting Criticism
- LAP 19 Building Sound Working Relationships
- LAP 20 Working Harmoniously with Others
- LAP 41 Employee Understanding and Cooperation

Other References

VICA Handbook

Program Goal: 8.0 The student will be able to use human relations skills that are appropriate to job success.

Course Goal:

8.2 The student will be able to demonstrate a positive attitude toward job.

- Safeworking attitude
- Responsible
- Punctual
- Honest
- Good health habits

Activities:

Make job attitude a part of the grading system for the vocational program.

Emphasize the importance of good job attitudes throughout all activities of the electrical program.

Make job assignments to reward students that demonstrate responsibility.

Invite resource persons from community to discuss the importance of job attitudes.

Use the VICA program as a way to improve attitudes toward the world of work.

Have students complete LAP assignments.

Referenced LAP (IDEC) Packages

HUMAN RELATIONS
- LAP 2 Orderly and Systematic Behavior
- LAP 4 Maintaining Good Health
- LAP 5 Honesty and Integrity On the Job
- LAP 17 Attitudes Toward Work

Other References

VICA Handbook

Program Goal: 8.0 The student will be able to use human relations skills that are appropriate to job success.

Course Goal:

8.3 The student will be able to accept leadership responsibilities in performance of job.

- Craftsmanship
- Responsibility for others
- Respect for others
- Willingness to accept help from others
- Willingness to give help to others

Activities:

Make "foreman" assignments that require students to supervise the work of others. The instructor can designate foreman and crew leaders for a performance activity that will give many students the opportunity for leadership.

Involve students in the on-going activities of the VICA Chapter as a method of leadership development.

Have students participate in VICA Achievement Program.

Have students complete LAP assignments when appropriate.

Referenced LAP (IDEC) Packages

HUMAN RELATIONS

LAP 7	Showing an Interest in Others
LAP 22	Recognizing the Needs and Motivations of Others
LAP 25	Influencing Others
LAP 26	Human Relations: A Great Responsibility
LAP 41	Employee Understanding and Cooperation
LAP 63	Recognizing Employee Accomplishments

Other References

VICA Handbook

COURSE GOALS

9.1 Identify jobs and working conditions for each of the key occupations in the electrical/electronic cluster.

9.2 Define requirements and routes for entry into each of the key occupations.

9.3 Describe the career ladders for advancement within each of the key occupations.

9.4 Use appropriate job search techniques.

9.5 Understand entrepreneurship opportunities in electricity and electronics.

Program Goal: 9.0 The student will be able to understand career options, career ladders and job search techniques of the electrical trades.

Course Goal:

9.1 The student will be able to identify jobs and working conditions for each of the key occupations in the electrical/electronic cluster.

- Duties
- Working conditions
- Salaries

Activities:

Have students analyze key occupations of construction using a worksheet for collecting information and the Dictionary of Occupational Titles.

Have students perform the QUEST search on a CIS terminal or needlesort.

Prepare lists of pay scales based on local wage rates.

Have resource persons explain their job roles to the students.

Have students make on-site observations of electrical/electronic workers.

Take field trips to work site.

References

See local counselor or career resource center for DOT and CIS references.

Assembler Package for Additional Reference
EA 02 Job Market

Program Goal: 9.0 The student will be able to understand career options, career ladders and job search techniques of the electrical trades.

Course Goal:

9.2 The student will be able to define requirements and routes for entry into each of the key occupations.

- Training requirements
- Physical requirements
- Entry routes

Activities:

Have students define the training requirements for each of the key occupations by completing the information on a worksheet.

Have students define the physical requirements needed for success in the electrical trades.

Use apprenticeship representatives as resource persons to explain how students can enter apprenticeship programs.

Use local community college electrical instructor to explain post secondary training option to students.

Summarize and clarify entry requirements and routings to students for key occupations and related occupations such as subassembly inspector.

References

See Career Resource Center staff at local school or contact Apprenticeship Council for needed information.

Program Goal: 9.0 The student will be able to understand career options, career ladders and job search techniques of the electrical trades.

Course Goal:

9.3 The student will be able to describe the career ladders for advancement within each of the key occupations.

- Upward mobility

Activities:

Have students define a career ladder for upward mobility in each of the key occupations.

Have students describe (in writing) the responsibilities for each job position in the career ladder, i.e., assembler, quality control inspector, junior technician, production technician, engineering technician.

Conduct a class discussion on the personal qualities needed for upward mobility.

Use resource persons as appropriate.

References

Contact Career Resource Center or counselor of local school.

Program Goal: 9.0 The student will be able to understand career options, career ladders and job search techniques of the electrical trades.

Course Goal:

9.4 The student will be able to use appropriate job search techniques.

- Job prospecting
- Job resume
- Job application
- Job interview
- Dress

Activities:

Have each student develop a list of potential employers where they would like to work.

Have students conduct job prospecting using a sequentially ordered worksheet of questions to be answered through prospecting.

Have students work with counselor, CWE Coordinator or English teacher to develop a job resume.

Have students fill out job applications (mock and/or real).

Have pairs of students do mock job interviews with one observer criticizing the interviews.

Use industry people in conducting simulated job interviews.

Have students prepare a portfolio for use in getting a job.

References

"Getting A Job" Southwestern Publishing Co. 855 California Avenue, Palo Alto, California 94304. (An individualized kit of materials)

Program Goal: 9.0 The student will be able to understand career options, career ladders and job search techniques of the electrical trades.

Course Goal:

9.5 The student will be able to understand entrepreneurship opportunities in electricity and electronics.

Activities:

Have students complete IDEC Packages that are appropriate to their individual interests.

Bring representative from Small Business Administration into classroom to explain procedures for operating a business.

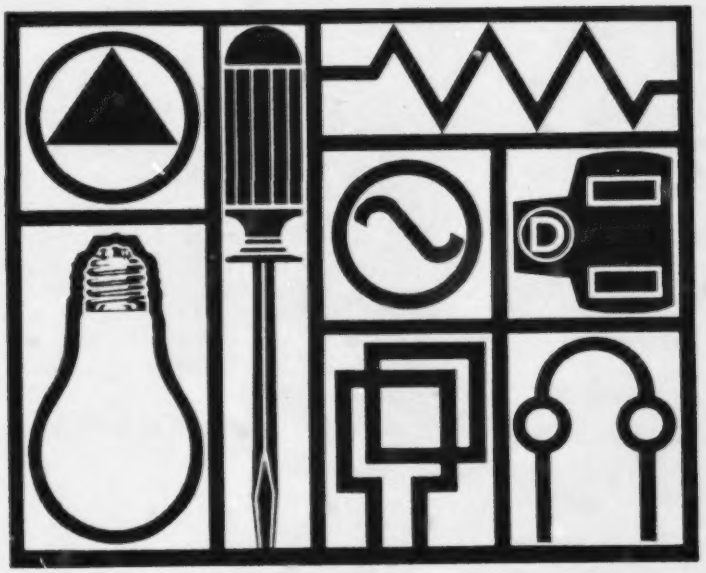
Bring in self-employed electrical trades people to share with the class; i.e., Radio/TV Repairer.

References

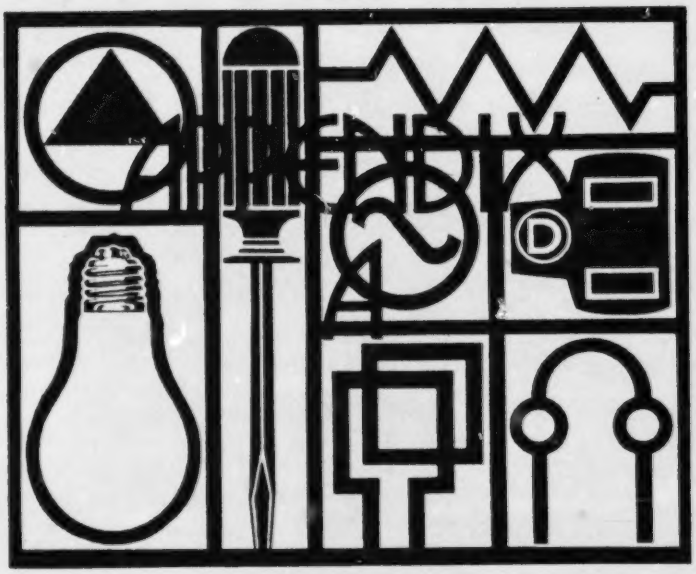
ENTREPRENEURSHIP TRAINING COMPONENTS
AMERICAN INSTITUTE FOR RESEARCH
STUDENT MODULES WITH TEACHER GUIDES

(SPECIFIC MODULE) GETTING DOWN TO BUSINESS:
Construction Electricity Business
ETC Module 100-MM-1 Instructor Module
100-MM-2 Student Module

(CORE MODULE) GETTING DOWN TO BUSINESS:
What's It All About?
ETC Module 100-C-1 Instructor Module
100-C-2 Student Module



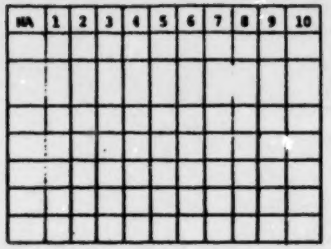
APPENDIXES



CERTIFICATE OF COMPETENCY

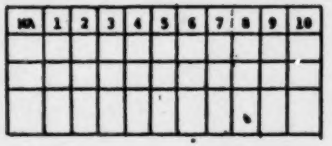
APPLIED MATHEMATICS & COMPUTER

a. Uses basic arithmetic functions
b. Uses basic algebraic and trigonometric functions
c. Uses basic computer numbering systems
d. Uses computer language skills, BASIC
e. Uses computer language skills, FORTRAN
f. Uses computer numbering skills, PASCAL
g. Uses calculus



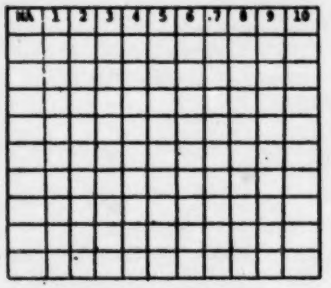
MAINTENANCE OF TOOLS AND EQUIPMENT

a. Identifies and uses basic hand tools
b. Identifies and uses basic power tools
c. Maintains hand and power tools for proper operation



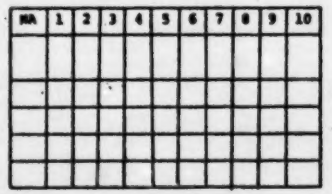
TESTING AND TROUBLESHOOTING

a. Can select correct test equipment
b. Can do basic circuit analysis
c. Maintenance of test equipment
d. Operates test equipment
e. DC systems - power
f. AC power distribution systems
g. Audio systems
h. RF systems
i. Digital systems



ASSEMBLY AND REPAIR OF ELECTROMECHANICAL EQUIPMENT

a. Identifies mechanical and electrical components
b. Assembles mechanical systems
c. Assembles electric/electronic systems
d. Solders and desolders
e. Connecting and disconnecting assemblies

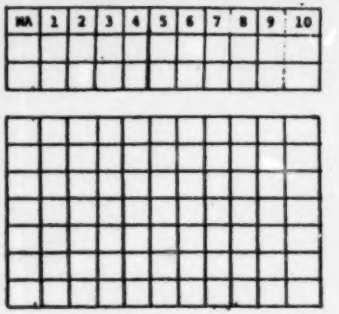


BASIC ELECTRIC/ELECTRONIC THEORY

a. Can apply the basic theories of DC
b. Can apply the basic theories of AC

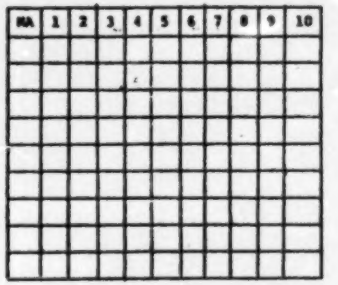
Can describe the basic operation of:

c. Power supplies
d. Amplifiers
e. Oscillators
f. RF communication circuits
g. Op amps
h. Digital fundamentals
i. Microprocessor applications

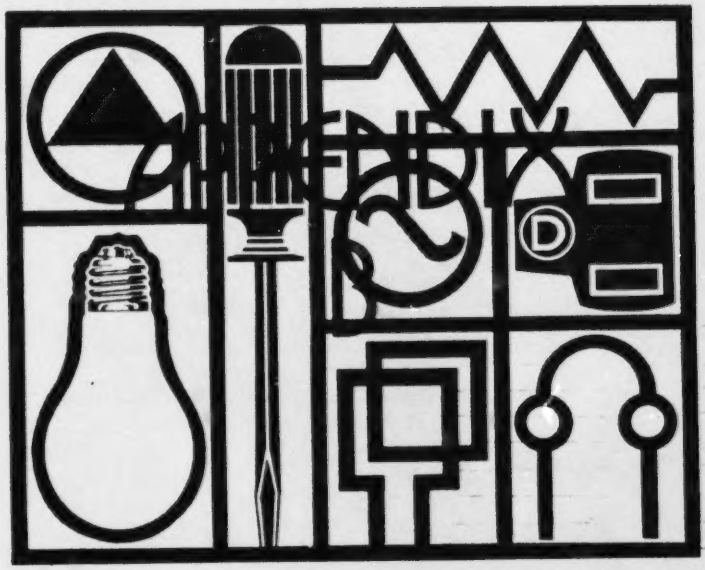


HUMAN RELATIONS

a. Trustworthy
b. Self-initiative
c. Self-reliance
d. Punctuality and attendance
e. Personal appearance
f. Leadership and assertiveness
g. Attitude
h. Respects the rights of others
i. Able to work with others



OTHER EXPERIENCE AND COMMENTS



JOB DESCRIPTIONS FROM

OREGON EMPLOYMENT
STATISTICS TITLES

OES CODE 32004
Electrical and Electronic Technicians

Count in this group technicians with a background in electrical or electronic theory, physical science, and mathematics which enable them to perform jobs above the routine operating or maintenance levels. Normally, such employees are engaged in constructing, repairing, testing, installing, modifying, operating, or even designing a variety of production or experimental types of complex electrical or electronic equipment.

OES CODE 55B12
Electrician

Installs, maintains, and repairs wiring, electrical equipment, and fixtures. Insures that work is in accordance with relevant codes and may read blueprints.

OES CODE 55D73
Household Appliance Repairer

Installs household appliances, such as refrigerators, washing machines, stoves, and television receiving sets, in customers home, using hand tools.

OES CODE 51055
T.V., Radio and Tape Recorder Repairer

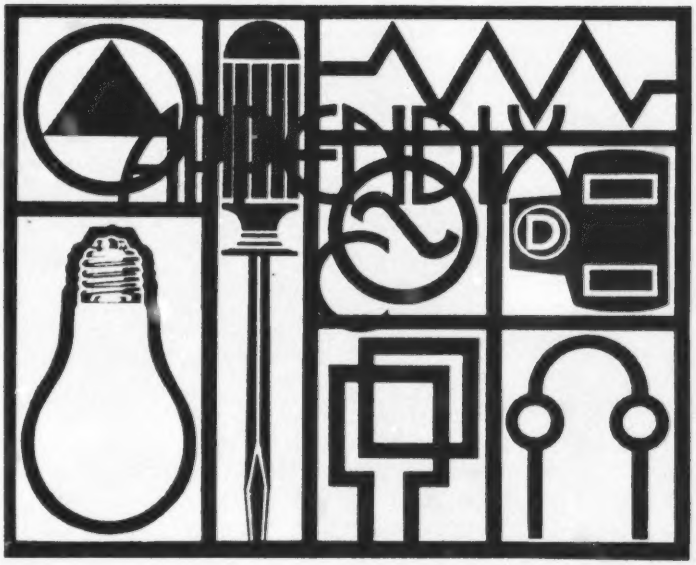
Repairs and adjusts radios and television receivers, phonographs, tape recorders, and other electronic audio equipment. May specialize in one area of repair and be designated Radio Repairer, Tape Recorder Repairer, etc.

OES CODE 55083
Electro-Mechanical Assembler

Assembles, tests, and prepares electro-mechanical equipment or devices, such as servomechanisms, gear trains, gyros, dynamometers, ejection seat mechanisms, wave guides, magnetic drums, tape drives, punched-card reading devices, brakes, control linkage, actuators and gearbox mechanisms according to specifications. This occupation requires specific vocational or on-the-job training of more than 30 days.

OES CODE 55U84
Electrical/Electronics Assemblers

Assembles or modifies prototypes of final assemblies of electrical or electronic equipment, such as missle control systems, radio and test equipment, computers, machine-tool numerical controls, radar and sonar, telemetering systems, appliances, etc. This occupation requires specific vocational or on-the-job training of more than 30 days.



MEDIA AND MATERIALS

An Accident Prevention Program for School Shops and Laboratories is an excellent source of safety ideas. The report is too long to be included in this guide, but it may be ordered from the U.S. Department of Health, Education and Welfare, Office of Education.

SOURCES FOR INDIVIDUALIZED PACKAGES

Individualized learning packages have been referenced to the course goals of this guide. The referenced packages can be obtained from the following sources:

ILS (Individualized Learning Systems)
Electronic and Electronic Assembler Modules

PSU/DCE
Community Services
P.O. Box 1394
Portland, OR 97207

LAP (Learning Activity Packages)
Human Relations Modules

Interstate Distributive Education Curriculum
Consortium (IDECC)
The Ohio State University
1166 Chesapeake Avenue
Columbus, OH 43212
Telephone: (614) 486-6708

ETC (Entrepreneurship Training Components)
Entreneurship Modules

Vocational Studies Center
University of Wisconsin-Madison
964 Educational Services Building
1025 West Johnson Street
Madison, Wisconsin 53706

ETC modules are developed with instructor and student versions of each area of entrepreneurship. A core module precedes the electricity specific module.

REFERENCE TEXTS

Grob, Bernard, Basic Electronics, New York, McGraw-Hill Book Company, 1977.

Fowler, Richard J., Electricity, Principles and Applications, McGraw-Hill Book Company, 1979.

Schuler, Charles A., Electronics, Principles and Applications, California, Pennsylvania, McGraw-Hill Book Company, 1979.

Secretary, National Electrical Code Committee, National Fire Protection Association Electrical Field Specialist, National Electrical Code, New York, McGraw-Hill Book Company, 1974.

Steinberg, William; Ford, Walter B., Electricity and Electronics Basic, Fourth Edition, Chicago, Illinois, American Technical Society, 1972.

Williams, Gerald, Electronics for Everyone, Scientific Research Associates, 1980.